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ABSTRACT

The results of five experiments investigating the effects of forced pauses and guided processing in an interactive videodisc instructional system are presented. The results indicate that forced pauses at strategic locations in an interactive videodisc tutorial may improve achievement for some students without interfering in the achievement of others. The use of guided processing is supported, but not under conditions of complete learner control. Further, the guidance should be used to remind learners to use the strategies they would normally use, such as self-pacing for movement from screen to screen, if the instruction was presented through other methods. Data are presented in both narrative and tabular formats. (13 references) (Author/DB)

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Wait Time and Guidance in Interactive Videodisc Instruction

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Abstract

The results of five experiments investigating the effects of forced pauses and guided processing in an interactive videodisc instructional system are presented. The results indicate that forced pauses at strategic locations in an interactive videodisc tutorial may improve achievement for some students without interfering in the achievement of others. The use of guided processing is supported, but not under conditions of complete learner control. Further, the guidance should be used to remind learners to use study the strategies they would normally use if the instruction was presented through other methods.

In the last 10 years, interactive video has been hailed as one of the most powerful educational media yet developed. Indeed, it has been used to teach a wide variety of topics and skills and continues to offer significant educational potential. However, little substantive research has been conducted to determine how best to use the technology, what design variables are important, and the instructional conditions under which the technology is appropriate (Hannafin, 1985; Smith, 1987; Smith & Lehman, 1988; Slee, 1989).

To help alleviate this problem, a series of interactive video studies investigating instructional variables was begun. These studies are a systematic investigation of several instructional variables and constructs, including location and duration of forced pauses, type and amount of learner control, type of guided processing to enhance comprehension, and learner perceptions of the material and its presentation. To date, five experiments have been completed. The results of these investigations, while specific to the instructional treatments described, have implications for other instructional media and interventions.

To determine a starting point for investigation, the nature of interactive videodisc presentation was considered. Because of the "multi-media" capabilities of an interactive videodisc system, the system has the potential to present information at a rate that may exceed the processing capabilities of the students using the system (Smith, 1988). In other words, complex information may be presented to fast for students to connect new information to existing knowledge structures, or comprehend.

A second feature of interactive videodisc presentations is the use of learner control. Laurillard (1984) suggests that learners should be given maximum control

over the instructional system. However, Hoekema (1983) indicates that the value of any learner controlled interaction must be considered in light of the instructional design used. Indeed, Hedberg, Perry, and McNamara (1985) suggest that excessive learner control may interfere with learning. In fact, there is evidence that people are poor judges of their state of learning in instructional situations where they receive little or no guidance (Tennyson & Buttrey, 1981). This suggests that it is possible that when faced with interactive videodisc technology, the learner's ability to process the information may be exceeded without the learner's awareness.

One common learner control feature is self-pacing for movement from screen to screen. Since pacing is frequently controlled by pressing a single key or set of keys, it is possible that students move from screen to screen more-or-less automatically, with little active processing of the material presented.

Given the factors identified above, it is essential that an interactive video instructional system use techniques to promote learning by defeating or circumventing these potential "road blocks" to learning brought by the student. One possible intervention that may be incorporated into instructional systems is the use of forced pauses with appropriate guidance, providing time for the recovery of processing resources and prompting for the integration of new information into existing structures.

Methodology

To investigate the effects of forced pauses and guidance, or "guided processing" (Hannafin, Phillips, & Tripp, 1986), a single basic tutorial program on DNA structure was developed around the Videodisc in Science Education (1982).

The program was selectively modified, allowing the use of identical treatments except for the variables in question in each experiment. The program used a mix of motion video, still video, and computer generated text as necessary to adequately present the information. The basic design of the program is shown in **Table 1**. Specific modifications for each experiment are discussed below.

Insert Table 1 about here.

In order to improve the possibility of detecting effects for the variables investigated, the instruction needed to be difficult, thereby increasing the processing demands for the students. DNA structure was selected as the topic for instruction because it is considered difficult for most students. To increase the effective difficulty level during the first four experiments, the population was restricted to non-biology students. Biology students were defined as biology majors and students currently enrolled in a biology course.

Experiment 1

In the first experiment the effect of strategically embedding forced pauses in the instruction was investigated (Smith, 1988). In considering the location and duration of the pauses, three types of locations could be defended, **Table 2**. Pauses located after presentations of the objectives for each part of the lesson would allow time to recall relevant prior learning, making connections between new and old knowledge easier. Pauses located after material was presented but before review questions and summaries allowed time to create knowledge structures specific to the individual student, enhancing learning or recall. Pauses located after

the summaries for each section would allow time to incorporate the structure provided into the learners knowledge base. In each case, the pauses should also allow for recovery of processing resources. The duration of the pauses was selected as 20 and 40 seconds, bracketing the durations used by others (Hannafin, 1985).

Insert Table 2 about here.

The subjects for this experiment were 115 volunteers from an undergraduate Educational Psychology course and an Undergraduate Restaurant and Hotel Institute personnel course at Purdue University. All students received course credit for participating. The credit was not based on the score on the posttest.

Specific answers to four questions were sought:

- What is the effect of pause location on achievement?
- What is the effect of pause duration on achievement?
- Is there an interaction between location and duration?
- What is the effect of the pause location and duration combinations on the difficulty of the material as perceived by the learners?

A 2 X 3 Factorial with Control Group design (Winer, 1971) was used since the control group could be classified only on the pause duration (PD) variable. The independent variables were pause duration (PD) and pause location (PL). The dependent variables were Score (S) on the posttest, Time (T) to complete the program (calculated by subtracting the total pause from the actual time), and student

ratings (R) of difficulty on a Likert-type scale. In addition, each subject was debriefed following completion of the posttest and ratings.

The results, **Table 3**, suggest that increased pause duration had a positive effect on scores for each location. Further, with the exception of the after objectives location, mean time to complete the program increased with the increase in duration. Except for the after summary group, the mean difficulty rating decreased with the increase in pause duration. However, the analysis of the data is not clear cut.

Insert Table 3 about here.

The 2 X 3 with Control design assumes that the within-cell sum of squares for the control group is homogeneous with the within-cell sum of squares for the 2 X 3. In addition, it assumes that the control group can be classified on one of the two independent variables, but not on the other. If either assumption is violated, the analysis becomes a 2 X 3 for the treatments (without the control) and a 1-way ANOVA to compare with the control group. For score, it was found that the assumption of homogeneity was violated, requiring the two step analysis, summarized in **Tables 4** and **5**.

Insert Tables 4 & 5 about here.

The 2 X 3 ANOVA for score showed that scores were significantly higher for PD = 40 than PD = 20, $F(1, 93) = 4.23$, $\alpha = 0.05$. Pause location and the

interaction were not significant. The 1-way comparison with the control group indicated no significant differences.

Unlike score, the assumption of homogeneity was not violated for time. Therefore, the 2 X 3 ANOVA with control was used. Since the control group could be classified in terms of PD, that main effect was adjusted and is indicated as PD' in **Table 6**. The analysis indicated that PL was significant at the $\alpha = 0.10$ level. No other significant effects were found. Since PL had 3 levels, a Duncan Multiple Range test was use to identify the significant level. The After Summary location resulted in significantly lower times to completion than did the remaining conditions.

Insert Table 6 about here.

The analysis of the difficulty rating was performed using a non-parametric 1-way ANOVA. No significant differences were found. Further, all groups rated the program as approximately neutral--neither easy nor difficult.

The debriefing results provided additional important information. Most subjects indicated that they liked the program. Few of them realized that features commonly found in instructional software (e.g. menu control, page back, and infinite review) were not available. Finally, of the subjects receiving the forced pauses (N = 99), more than 50 percent responded that they did use the pauses to think about the material.

Conclusions:

The worst case conclusion from these results is that pause durations of up to 40 seconds do not interfere with learning, which may have practical implications for the use of videotape. It is possible to design an interactive videotape lesson that has few, if any, access time pauses longer than 40 seconds. If the design places searches for instructional segments at logical or natural breaks in the material, the pauses may be used as an instructional feature and at least should not interfere with learning.

While the large variance of the control group overcomes any potential differences, making definitive conclusions impossible, it appears that pauses of 40 seconds are superior to pauses of 20 seconds at any of the locations tested. Taken by itself, this difference suggests that the pauses may allow the recovery of processing resources and provide time for connecting new information to old.

While it is possible that the large variance of the control group is an anomaly, one alternative explanation is that the use of the pauses reduced the variance that would have been present if the students were left to themselves. This suggests that better students are more effective at connecting new information to old (learning) than poorer students and that the pauses allow time for the poorer students to make the same connections. If this is the case, providing the pauses may be an appropriate strategy, especially since they do not appear to interfere with learning.

Pause location did not have any effect on scores, but did have a marginal effect on time to complete the program. Taken by itself, the result suggests that placing pauses after summaries is the most efficient condition. However, this result

is for time measured by subtracting the total time of the pauses in the program. When that time is added, there is no practical difference between the treatments.

Experiment 2

While the results of Experiment 1 were not definitive, there was sufficient evidence to warrant further investigation. A post hoc analysis of the question about the use of the forced pause indicated that there was a location effect for the number of people who took advantage of the time, X-square = 0.04. Examination of the data showed that more people in the After Content condition took advantage of the time. Further analysis showed that there was a significant difference, $\alpha = 0.10$, for score between those who did think about the material during the pauses and those who did not, $F(1, 96) = 3.21$, $p < 0.08$.

These results suggest that for the conditions of Experiment 1, the After Content, 40 Second condition is superior. However, that experiment compared guided processing in the pause conditions with no guided processing in the control conditions (a time of 0 precluded the use of a guided processing message). Thus, Experiment 1 did not consider the effect of guided processing under learner control.

Experiment 2 (Smith & Doyle, 1989) examined the effects of forced pause guided processing and self-paced guided processing in the after content condition. The program used in this experiment was identical with Experiment 1, except for the use of the self-paced message versus the forced pause message. The guided processing message was "Consider the material presented so far." Except for the subject population, all other conditions for the experiment were the same as in Experiment 1.

Sixteen students from a graduate educational computing course at Purdue University were randomly assigned to one of the two treatments. Subjects received course credit for participating. As in Experiment 1, the credit was not based on the posttest score. Subjects were debriefed using the same questions, except for modifying one question to ask "Did you use the screen 'Consider the material...' to review?".

As in Experiment 1, two of the dependent variables were score (S) and adjusted time (AT) calculated by subtracting the time spent on the guided processing screens from the total time. In addition, the total time to complete the programs (TC) was used. The rating of perceived difficulty (R) was also examined. The independent variable was the group (G) at two levels: forced pause and self-paced pause. The results are summarized in **Table 7**.

Insert Table 7 about here.

A 1-way ANOVA for score, **Table 8**, indicated that the difference was significant at the $\alpha = 0.05$ level, $F(1,14) = 5.09$, $p < 0.04$. The 1-way ANOVA's for total time to complete the program (TC) and adjusted time to complete the program (AT) were not significant, **Tables 9** and **10**. The ANOVA for the difficulty rating indicated no significance. Subjects rated the difficulty as neutral, **Table 11**.

An examination of the durations of the self-paced pauses, **Table 12**, provided some insight into the effect of guidance under complete learner control. The mean time over all of the guided processing screens was 2.82 seconds.

However, that is deceptive, since the mean times actually decreased from the first pause, mean 3.64 seconds, to the fourth pause, mean 2.33 seconds. Unlike Experiment 1 where subjects indicated that the program presented about the right amount of information for the time they spent, subjects in Experiment 2 said the amount of information was too high for the time they spent on the program.

Insert Tables 8 through 12 about here.

Conclusions:

Although the power of this experiment is too low to allow generalizing, it appears that for this group, the forced pause was more effective and just as efficient for learning. In addition, since there was no difference in time to complete the program, and much less time was spent on the guided processing screens, the self-paced group was spending additional time elsewhere in the program, perhaps in an effort to master the material. However, that additional time was not as effective as the forced pauses after content.

The pattern of self-paced pauses suggests that after the first guided processing screen, subjects automatically paged forward as soon as they realized what the message was, rather than take time to think about the information that had been presented in that section of the program. This automatic response prevented the opportunity to restore processing resources that may have been exceeded, as well as time to connect new knowledge to old.

As in Experiment 1, the results of the debriefing indicated that the subjects enjoyed the presentation. Although taking an educational computing course, they

did not realize that common CAI features were not available. Like Experiment 1, the presence or absence of the forced pause of 40 seconds had no effect on learner perceptions about the program, even though several thought the pauses were too long (forced pause condition).

The results of this experiment, when considered with those of Experiment 1, suggest that pause time may be an important instructional variable, though its use is largely unexplored.

Experiment 3

Because of the low power of Experiment 2, the third experiment was identical to Experiment 2, with two exceptions. The subjects were sixteen graduate students in an educational computing course at the University of Northern Colorado. The laboratory in which the experiment was conducted was not as isolated as the laboratory at Purdue University. The latter difference may have confounded the results, since it is possible that subjects were distracted, breaking their concentration on the information in the program.

The results of the experiment are summarized in **Table 13**. In this experiment, the ANOVA's for score (S), time to complete (TC), adjusted time (AT), and difficulty (R) were all nonsignificant, **Tables 14**, **15**, **16**, and **17**.

Insert Tables 13 through 18 about here.

Conclusions:

As in Experiment 2, the mean pause durations on the self-paced guided processing screens decreased with each subsequent screen, **Table 18**. However, an examination of the data indicated enough violations to the pattern that with a sample this small, no conclusions could be drawn about the pattern. The best that can be said is that it did not support or reject conclusions drawn from Experiment 2.

At first glance, these results are in direct conflict with the results of Experiment 2. It may be that because of the small N used in each experiment, an anomaly in either direction may have occurred. In the case of this experiment, however, there is an alternative explanation--possible confounding due to distraction from others in the computer laboratory. If subjects were distracted, they would not have scored well in either treatment. Another alternative might be a different attitude on the part of the subjects, since they received course credit no matter the outcome of the experiment. If they viewed the experiment as simply putting in time, they too would not have scored well. This position is supported to a degree by the large variance for both groups, especially when compared with the variance for Experiment 2.

As noted for Experiment 2, the power of this experiment is too low for definitive conclusions. Considered with the first two experiments, it is difficult to draw any guidance for the use of pauses or wait time in an instructional treatment. One possibility is that the effect of pauses and minimal guidance (as in the guided processing message in these experiments) is too small to be detected alone. This would explain the varying results in these experiments. If, however, the evidence of the first experiment is weighted somewhat heavier, having a much larger N, it

might be that pauses combined with additional instructional variables and/or more extensive guidance might have a positive effect.

Experiment 4

To begin investigating the inclusion of additional variables and extended guidance, several new versions of the biology program were developed and piloted with graduate students in educational computing and educational psychology at the University of Northern Colorado. Since this was a pilot of the new versions, the n for each treatment is highly variable and insufficient for more than a description. With the exception of the changes in the programs, the experiment was conducted in the same manner as Experiment 3 (with the same possible confounding conditions).

Two different modifications were made. In one set of two programs, the ability to page back was added. The guided processing message remained the same. In one program a forced pause was used for the guided processing screen. If the learner elected to page back on the question screen immediately following the pause, the guided processing screen was skipped. In other words, the guided processing screen could be encountered only in the forward direction. In the second program, the guided processing screen was self-paced. This set will be called "Page-Back."

The second set of two programs continued with the linear format, but changed the guided processing message to "Consider the material presented so far. Write down 3 important points." As before, this processing message was

presented either in a forced pause of 40 seconds or as a self-paced screen. This set will be called "Extended Guidance."

Conclusions:

For the Page Back groups, one subject had the self-paced guided processing screen. Three subjects had the force pause. None of the subjects paged back to review information on any screen. Further, the self-paced subject rated the difficulty as high. Of the forced pause subjects, two indicated that the difficulty was low, while one rated the material as extremely difficult. The high difficulty rating was obtained from the person with the lowest score. One explanation for the lack of paging back may be due to the fact that the course grade did not depend on the score on the test. Since there was little riding on mastery of the material, the subjects did not attempt to review when they felt the information was difficult. However, this is somewhat questionable, in light of the rating of low difficulty from two of the subjects.

For the subjects in the Extended Guidance condition, ratings of difficulty were uniformly high. Two subjects received the forced pause and three received the self-paced screen. Scores were highly variable, possibly for the reasons already noted. Although the data does not lend itself to analysis, one important factor was observed. While all subjects had paper and pencil provided, none spontaneously began taking notes on the material, as they would in a lecture. Upon encountering the guided processing message, all five began to take notes. However, the notes were not necessarily taken during the time the guided processing message was on the screen. This suggests that upon encountering a technology such as computer-based instruction, students assume the computer will do all of the work (or some

similar assumption) and that they do not need to add effort of their own. Once they are reminded that the situation is still one of student and learning/instruction, they begin to utilize the study skills they would use in more traditional settings. This result suggests that including explicit study strategy guidance in the instructional treatments may benefit students and improve learning.

Experiment 5

In the fifth experiment, the Extended Guidance condition from experiment 4 was studied. Twenty three students were drawn from a graduate class on computers in education and randomly assigned to one of the two treatments. However, this time performance on the post test accounted for 40 % of the grade on the activity. Because the score on the test did impact the grade for the exercise and thus the course grade, students were motivated to learn. Additionally, the study was conducted in a research and development laboratory, reducing the interference from the general lab environment. Other activities did take place in the development laboratory, but they were isolated and much less distracting than conditions in the general lab.

The results of the experiment are summarized in **Table 19**. As is Experiment 3, the ANOVA's for score (S), time to complete (TC), adjusted time (AT), and difficulty (R) were all nonsignificant, **Tables 20**, **21**, **22**, and **23**.

Insert Tables 19 through 24 about here.

An examination of the pause times for the self-paced group reveals that the pattern of decreasing mean durations does not hold, **Table 24**. Examination of the raw data indicates that two subjects spent an abnormally long amount of time on the guidance screens, in comparison to the other subjects. Looking at the remaining 9 subjects, there is a large decrease in pause time between the first and second pauses, **Table 25**. The rest of the pauses show the decrease in mean time found in earlier experiments, indicating that those 9 students simply automatically continued on to the next screen (the summary of the chapter) without following the directions.

Insert Table 25 about here.

When asked whether they followed the directions on the guidance screen, 7 people in the self-paced group said yes, 3 indicated no, and 1 did not remember. In the forced-pause group, 8 indicated yes and 4 no. However, all subjects were observed by the author during the experiment. No subject began taking notes prior to the first guidance screen. Further, all subjects began to take notes throughout the remainder of the program.

Conclusions:

Although the Forced Pause group had a higher mean score, it was not significantly higher. Time to complete the program was not significantly different. Indeed, there were no significant differences on any of the measures. These results do not support the idea that providing a forced delay for reflection and recovery of processing resources may improve learning in an interactive videodisc setting, even with the use of limited guidance. However, the experiment does show that learners

in an interactive videodisc instructional setting need to be reminded to use study strategies already learned in order to maximize their achievement. This is particularly cogent in light of the fact that in this study performance on the test has an impact on the course grade, providing motivated learners.

Conclusions

The strongest conclusion that can be drawn from these experiments is that presentation time or access time is not an important issue; at least in the sense that information must be presented as fast as possible. The forced pause groups had higher scores in all of the experiments (except 4) reported here, although Experiments 3 and 5 were not significantly different. Further this result, along with the results of others (e.g. Hannafin, 1985; Hannafin, Phillips, & Tripp, 1986), indicates that for some people and in some conditions, using wait time as an instructional strategy has a positive effect on learning. Further, the use of the forced pauses did not appear to have a negative effect on achievement. This suggests that forced pauses may be a useful instructional variable, since they didn't hinder learning or affect learner perceptions and for some learners may have helped.

A second important result is that for those students who indicated that they did use the time (in a forced pause condition) to think about the material, learning increased. This result supports the idea of providing guidance. However, in considering all of the experiments together, the use of guidance with complete learner control is not well supported. The time spent on the guided processing screens when self-pacing was used suggests that simply indicating what should be done at that point in the lesson is not sufficient to insure active processing of the

information. This suggests that the design of instructional materials, especially those intended to stand alone, must use strategies to promote appropriate study habits for the learner.

The results of the pilot materials (Experiment 4) suggested two major factors. First, the option for paging back to review was not used by the subjects. This suggests that the feature needs further investigation to determine when and for what groups it is important. The pilot suggests that page back control is not an important feature, which contradicts the usual position on learner control.

The second factor, Extended Guidance, was investigated in both the pilot and Experiment 5. Results suggest that reminding students of appropriate study strategies could be part of the introductory material for an instructional program. By reminding them of these strategies, the potentially passive nature of the instruction/learning may be overcome, improving learning.

Although these results suggest possible strategies for the design of interactive videodisc instruction, they are, at best, preliminary. They do not provide sufficient evidence for a viable model of the use of pause time or guided processing as instructional variables under the control of the designers. Indeed, these experiments raise a number of issues.

One area for immediate consideration is a repeat of Experiments 2, 3, and 5 with a much larger N, increasing the power of the results. This would provide a better indication of the mechanisms operating in those conditions.

A second area is concerned with overcoming the automatic paging response on the guided processing screens. This could be accomplished by using a 5 second delay before the learner is allowed to page forward. Since 5 seconds is longer than

the mean time spent on that screen under complete learner control condition, it may be enough to cause the learner to stop, consider the message, and possibly act on the message.

The conditions examined in the pilot studies (Experiment 4) should be tested with larger samples, in an effort to gain quantitative data. The features in each pilot could be combined with each other as well as additional variables, such as menu control. This would lead to the creation of a more robust picture of the value of various instructional design variables.

Another series of extensions, suggested in a discussion with Kyle Peck (1990) would be to implement the Extended Guidance messages by randomly interrupting the program to remind the learners about particular points of importance or appropriate study skills. While complete randomization of the guidance would make analysis difficult, and while it cannot be fully defended from a cognitive point of view. Limited use of the technique could be defended and implemented through the identification of location types within the treatment that fit predetermined criteria such as use or nonuse of control features for review of incorrect answers to review questions.

Initially, a similar population should be used for all of these studies, allowing for some comparison of results. However, the population currently in use, graduate students, is not readily generalizable. Another series of experiments should be conducted that use a wide variety of populations, allowing the formulation of a general model. In addition to additional populations, similar program structures should be tested for other content areas. This would overcome the limited generalizability of results from only one content, biology.

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Table 1. Basic Program Design

Segment	Structure
Orienting Material	Content
Chapter 1	Objectives Content Review Questions Summary
Chapter 2	Objectives Content Review Questions Summary
Chapter 3	Objectives Content Review Questions Summary
Chapter 4	Objectives Content Review Questions Summary
Summary	Content

Table 2. Pause Locations

Segment	After Objectives	After Content	After Summary
Orienting	Content	Content	Content
Chapter 1	Objectives	Objectives	Objectives
	Pause	Content	Content
	Content	**Pause**	Review Ques.
	Review Ques.	Review Ques.	Summary
	Summary	Summary	**Pause**
Chapter 2	Objectives	Objectives	Objectives
	Pause	Content	Content
	Content	**Pause**	Review Ques.
	Review Ques.	Review Ques.	Summary
	Summary	Summary	**Pause**
Chapter 3	Objectives	Objectives	Objectives
	Pause	Content	Content
	Content	**Pause**	Review Ques.
	Review Ques.	Review Ques.	Summary
	Summary	Summary	**Pause**
Chapter 4	Objectives	Objectives	Objectives
	Pause	Content	Content
	Content	**Pause**	Review Ques.
	Review Ques.	Review Ques.	Summary
	Summary	Summary	**Pause**
Summary	Content	Content	Content

Table 3. Experiment 1 Results

		Pause Location								
		After Objectives			After Content			After Summary		
		Score	Time	Rating	Score	Time	Rating	Score	Time	Rating
40 S	Mean	21.06	1172.2	3.13	23	1281.5	3.06	21.94	1147.0	3.29
	St.Dev.	5.70	136.1		4.76	196.8		6.39	177.9	
Pause Duration										
20 S	Mean	17.75	1256.7	3.50	19.44	1156.1	3.33	20.75	1060.0	3.00
	St.Dev.	7.53	350.6		5.73	258.0		6.20	164.9	
0 S	Mean	20.19	1121.9	3.07						
	St.Dev.	7.93	166.7							

Table 4. 2 X 3 ANOVA for Score

Source	df	SS	MS	F
Between	5	282.82	56.56	1.52
PD	1	157.74	157.74	4.23*
PL	2	95.87	47.94	1.28
PD X PL	2	36.86	18.43	0.49
Within	93	3470.35	37.32	

* Significant at $\alpha = 0.05$ level.

Table 5. 1-Way ANOVA for Score.

Source	df	SS	MS	F
Group	6	286.99	47.83	1.17
Within	108	4414.79	40.88	

Table 6. 2 X 3 ANOVA with Control for Time.

Source	df	SS	MS	F
Between	6	478182.82	79697.14	
Cont. vs all	1	67530.15	67530.15	1.46
PD	1	34896.21	34896.21	0.75
PL	2	243118.65	121559.33	2.62*
PD X PL	2	132637.81	66318.91	1.43
Within	107	4955499.65	46313.08	
PD'	2	103655.04	51827.52	1.12

* Significant at $\alpha = 0.10$ level.

Table 7. Results of Experiment 2.

		Score	Time	Adjusted Time	Rating
Forced	Mean	24.5	1278.36	1118.20	3.0
	St. Dev.	5.01	108.42	108.42	1.07
Self-Paced	Mean	19.25	1227.46	1216.17	3.75
	St. Dev.	4.27	219.53	219.54	1.04

Table 8. 1-Way ANOVA for Score, Experiment 2.

Source	df	SS	MS	F	p
Group	1	110.25	110.25	5.086	0.04
Error	14	303.5	21.68		

Table 9. 1-Way ANOVA for Time to Complete, Experiment 2.

Source	df	SS	MS	F	p
Group	1	10364.13	10364.12	0.35	0.57
Error	14	419644.76	29974.63		

Table 10. 1-Way ANOVA for Adjusted Time, Experiment 2.

Source	df	SS	MS	F	p
Group	1	38389.71	38389.71	1.28	0.277
Error	14	419691.344	29977.95		

Table 11. 1-Way ANOVA for Difficulty Rating, Experiment 2.

Source	df	SS	MS	F	p
Group	1	2.25	2.25	2.03	0.18
Error	14	15.50	1.11		

Table 12. Self-Paced Pauses on Guided Processing Screens, Experiment 2.

Subject #	Screen 1	Screen 2	Screen 3	Screen 4	Mean
1	5.77	2.75	1.98	1.59	3.02
2	3.35	1.54	1.65	1.54	2.02
3	3.46	5.22	3.19	2.58	3.61
4	4.28	2.42	1.76	1.87	2.58
5	2.69	3.08	2.25	1.81	2.46
6	3.30	1.98	5.82	5.10	4.05
7	3.41	3.46	2.80	2.58	2.06
8	2.86	1.70	1.04	1.54	1.79
Mean	3.64	2.77	2.56	2.33	2.82
St. Dev.	0.98	1.19	1.48	1.20	0.77

Table 13. Results of Experiment 3.

		Score	Time	Adjusted Time	Rating
Forced	Mean	19.5	1400.82	1240.66	4.0
	St. Dev.	6.12	155.02	155.02	1.31
Self-Paced	Mean	18.75	1268.17	1252.37	4.12
	St. Dev.	7.10	329.00	316.36	0.83

Table 14. 1-Way ANOVA for Score, Experiment 3.

Source	df	SS	MS	F	p
Group	1	1.56	1.56	0.04	0.85
Error	14	614.88	43.92		

Table 15. 1-Way ANOVA for Time to Complete, Experiment 3.

Source	df	SS	MS	F	p
Group	1	70386.02	70386.02	1.06	0.32
Error	14	925918.22	66137.02		

Table 16. 1-Way ANOVA for Adjusted Time, Experiment 3.

Source	df	SS	MS	F	p
Group	1	548.82	548.82	0.01	0.93
Error	14	868824.60	62058.90		

Table 17. 1-Way ANOVA for Difficulty Rating, Experiment 3.

Source	df	SS	MS	F	p
Group	1	0.06	0.06	0.05	0.82
Error	14	16.88	1.20		

Table 18. Self-Paced Pauses on Guided Processing Screens, Experiment 3.

Subject #	Screen 1	Screen 2	Screen 3	Screen 4	Mean
1	2.58	1.70	1.59	1.21	1.77
2	2.25	2.20	1.65	1.59	1.92
3	8.24	4.34	2.58	3.02	4.54
4	3.40	1.76	5.22	2.86	3.31
5	2.42	1.76	3.13	1.59	2.22
6	49.43	3.07	1.87	1.48	13.96
7	2.03	3.24	1.32	1.87	2.12
8	2.75	1.48	1.81	0.93	1.74
Mean	9.14	2.44	2.40	1.82	3.95
St. Dev.	16.41	1.01	1.28	0.74	4.16

Table 19. Results of Experiment 5.

		Score	Time	Adjusted Time	Rating
Forced	Mean	28.2	2182.77	2022.61	3.58
	St. Dev.	5.24	802.50	802.50	1.08
Self-Paced	Mean	25.0	1981.89	1919.03	4.09
	St. Dev.	6.54	542.50	531.58	0.53

Table 20. 1-Way ANOVA for Score, Experiment 5.

Source	df	SS	MS	F	p
Group	1	57.55	57.55	1.66	0.21
Error	21	729.67	34.75		

Table 21. 1-Way ANOVA for Time to Complete, Experiment 5.

Source	df	SS	MS	F	p
Group	1	231598.01	231598.01	0.485	0.49
Error	21	1.0027E+7	477484.85		

Table 22. 1-Way ANOVA for Adjusted Time, Experiment 5.

Source	df	SS	MS	F	p
Group	1	61580.59	61580.59	0.13	0.72
Error	21	9909926.12	471901.24		

Table 23. 1-Way ANOVA for Difficulty Rating, Experiment 5.

Source	df	SS	MS	F	p
Group	1	1.48	1.48	1.96	0.18
Error	21	15.83	0.75		

Table 24. Self-Paced Pauses on Guided Processing Screens, Experiment 5.

Subject #	Screen 1	Screen 2	Screen 3	Screen 4	Mean
1	11.20	3.84	2.52	2.58	5.04
2	18.62	2.58	4.61	1.81	6.91
3	10.38	43.67	36.69	62.94	38.42
4	39.05	2.69	2.19	2.14	11.51
5	4.61	2.80	2.91	1.76	3.02
6	24.33	5.21	2.91	2.25	8.67
7	45.48	2.69	2.47	1.70	13.09
8	6.26	4.06	2.42	4.83	4.39
9	37.41	1.92	1.76	2.09	10.79
10	62.94	79.97	45.64	75.85	66.10
11	5.93	5.93	3.90	3.90	4.91
Mean	24.20	14.13	9.82	14.71	15.71
St. Dev.	19.44	24.97	15.65	27.21	19.36

Table 25. Self-Paced Pauses on Guided Processing Screens, Experiment 5.

Subject #	Screen 1	Screen 2	Screen 3	Screen 4	Mean
1	11.20	3.84	2.52	2.58	5.04
2	18.62	2.58	4.61	1.81	6.91
4	39.05	2.69	2.19	2.14	11.51
5	4.61	2.80	2.91	1.76	3.02
6	24.33	5.21	2.91	2.25	8.67
7	45.48	2.69	2.47	1.70	13.09
8	6.26	4.06	2.42	4.83	4.39
9	37.41	1.92	1.76	2.09	10.79
11	5.93	5.93	3.90	3.90	4.91
Mean	21.43	3.52	2.86	2.56	7.59
St. Dev.	15.88	1.34	0.88	1.08	3.58